DESCRIPTION

METHOD OF PROCESSING FEMALE SPLINE OF HUB UNIT FOR SUPPORTING WHEEL

Technical Field

The present invention relates to a hub unit for supporting a wheel which is attached to an automobile, or the like, and particularly, to a method of processing a female spline which is formed on a shaft portion of this hub unit.

Background Art

In a conventional method of changing the form of a female spline of a hub unit and of processing the female spline, as shown in Fig. 11, a jig 15 is abutted against an inner wall of a spline hole 3a which is formed on a hub shaft portion 3c of a work 103 for a hub unit to effect plastically deforming by caulking (or clinching) so that a material is prevented from being extruded (see, for example, Japanese Patent Application Laid-Open No. 2001-162338). This arrangement is effective in increase of the axial force. In Fig. 11, a reference numeral 16 denotes an outer race which is fitted on the hub shaft portion 3c through bearings 18; and 17 an inner

race element to be press-fitted on the hub shaft portion 3c.

Also, in the conventional method of forming and processing a female spline of a hub unit, as shown in Fig. 12, there is provided a portion which is extended in midair between a female spline portion 3e and a portion 3 to be plastically deformed formed on the hub shaft portion3c of the work 103 for the hub unit, as a buffer portion X (see, for example, Japanese Patent Application Laid-Open No. 2002-29210). This arrangement is effective in suppressing deformation of the female spline portion caused by plastically deforming.

Further in the conventional method of processing a female spline of a hub unit, the female spline of the hub unit is processed by broaching (see, for example, Japanese Patent Application Laid-Open No. 2002-61661). This arrangement is advantageous in regulating the surface roughness of the female spline. Still further, in this processing method, though a hub unit is different from that of the present invention since comprising a hub wheel and a constant velocity joint combined with each other, a female spline is in some case formed by machine work such as broaching, hardening processing, or polishing (see, for example, Japanese Patent Application Laid-Open No. 2002-301407).

Further, in order to prevent the diameter of a serration from being contracted by plastically deforming, the female spline of the hub unit is subjected to broaching after the shaft portion is plastically deformed caulking (or clinching) (see, for example, Japanese Patent Application Laid-Open Nos. 2002-283804 and 2002-89572).

However, in the processing method disclosed in the Japanese Patent Application Laid-Open No. 2001-162338, out of the methods of processing the female spline of the hub unit described above, it is practically impossible to manufacture a jig 15 which is in contact with all of the surfaces of the female spline because of a processing error of the female spline. As a result, there arises a problem that a surface of the spline with which the jig 15 is not in contact is exposed upon plastically deforming by caulking (or clinching) so that the form of the spline is not as designed.

In the method disclosed in Japanese Patent Application Laid-Open No. 2002-29210, when the axial length of the hub unit is limited, it is required to reduce the length of the female spline portion 3e. For this reason, the length of a surface of contact between the female spline 3e of the hub unit 103 and a female spline of the constant velocity joint is shortened, so that the torque transmission can not be

carried out with efficiency. That is, there is a problem that, when the hub unit is required to have a certain length of the female spline or when the hub unit has a comparatively small axial length, this processing method can not be employed.

In the method disclosed in the Japanese Patent Application Laid-Open No. 2002-283804 and the method disclosed in the Japanese Patent Application Laid-Open No. 2002-89572, the female spline of the hub unit is subjected to broaching after the shaft portion is plastically deformed by caulking (or clinching) so as to avoid the contraction of the diameter of the serration caused by the plastically deforming by caulking (or clinching). However, since neither semi-drying process nor drying process is conducted, a washing step after the treatment can not be omitted. Also since the broaching is not carried out by shielding chips, when the hub unit incorporates therein an encoder formed of multipolar magnet, there is a fear that the chips adhere to the encoder so as to deteriorate a rotation detecting function of a sensor which is used with the encoder to make a set.

Disclosure of the Invention

An object of the present invention is to provide a method of processing a female spline of a hub unit

for supporting a wheel which can solve the problems of the prior art described above, can process the female spline with precision, and can omit a washing step after the treatment.

In order to achieve the above object, according to one aspect of the present invention, a bearing of which a hub shaft portion is formed by cutting with a hole extended in the axial direction, and after an inner race thereof is fixed by plastically deforming by caulking (or clinching) to form a work for a hub unit, a female spline is formed on the hole by semi-dry or dry broaching. It is preferable that the above hole is formed to have a greater part for an estimated amount of contraction caused by the plastically deforming by caulking (or clinching) or the press-fitting of the inner race element at a portion closer to a portion plastically deformed by caulking (or clinching) of the shaft portion.

According to another aspect of the present invention, the female spline is roughly processed by broaching on the shaft portion of the work for a hub, and then a bearing is fitted on the shaft portion and an outer end of an inner race of the bearing is fixed by plastically deforming by caulking (or clinching) at an end of the shaft portion in the axial direction. After that, the female spline is finished by semi-dry or dry broaching. The rough broaching of the females

spline is preferably performed in the following manner. A ring is press-fitted on the shaft portion having a cylindrical hole of the hub unit or a part of the shaft portion is chucked, whereby this hole is made to have the form being narrower for an amount of contraction by plastically deforming by caulking (or clinching), or press-fitting of the inner race element at a portion nearer the portion plastically deformed by caulking (or clinching) of the shaft portion. The broaching is carried out in this state.

By employing such a processing method as described above, it is possible to prevent a lower part of the female spline hole from being swollen and deformed, whereby the female spline can be formed with precision, without increasing the number of the processing steps.

In addition, the cost for finishing the female spline can be reduced, by conducting rough processing of the female spline beforehand.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view for showing a structure of a broaching work related to the present invention, when a work for a hub unit is turned up;

Fig. 2 is a cross sectional view for showing a structure of the broaching work related to the present invention, when a work for a hub unit is

turned down;

Fig. 3A and Fig. 3B are for showing a cross section of the work for the hub unit prior to the broaching work, wherein Fig. 3A shows a shape of a hole for forming a spline before plastically deforming by caulking (or clinching), and Fig. 3B shows the shape after plastically deforming by caulking (or clinching);

Fig. 4A and Fig. 4B are respectively whole and partial cross sectional views for showing a seal attached to the work for the hub unit;

Fig. 5 is a lateral sectional view for showing a state in which the work for the hub unit is carried in during the broaching work related to the present invention;

Fig. 6 is a lateral sectional view for showing a state in which a tool is inserted through the work for the hub unit in the broaching work;

Fig. 7 is a lateral sectional view for showing a state in which a spline processing is carried out by broaching;

Fig. 8 is a lateral sectional view for showing a state before the hub unit is carried out after the broaching work;

Fig. 9A and Fig. 9B are cross sectional views for showing a rough processing for forming the spline of the work for the hub for hub unit formation,

wherein Fig. 9A shows a state before the broaching work, and Fig. 9B shows a state after the broaching work;

Fig. 10A is a partial cross sectional view of the hub unit in the axial direction, and Figs. 10B to 10E are characteristic diagrams for respectively showing deformation data of a spline hole of the hub unit;

Fig. 11 is a cross sectional view of a work for a hub unit for showing a conventional processing method of spline formation using a jig; and

Fig. 12 is a partial cross sectional view of a work for a hub unit for showing a conventional method of forming and processing a spline by arranging a buffer portion between a spline portion and a portion plastically deforming by caulking (or clinching).

Embodiment of the Invention

An embodiment of the present invention will be described below with reference to the drawings.

Description will be made on a work 103 to be processed by a method of the present invention which will be specifically described in the following with reference to Figs. 3A and 3B. The work 103 comprises a hub 3 which integrally has a shaft portion 3c and a flange 3b for supporting a wheel, an inner race element 17 which is press-fitted on the hub shaft

portion 3c at a predetermined portion on the outer periphery thereof, an outer race 16 which is concentric to the hub shaft portion 3c and the inner race element 17 and distant therefrom in the radial direction to be opposed thereto and has a flange 16a to be connected and fixed to a knuckle of a suspension, and two rows of balls 18 which are interposed between the inner periphery of the outer race 16 and the outer peripheries of the shaft portion 3c and the inner race element 17 and constitute a rolling bearing together with these members. This work 103 has been assembled in advance as a hub unit work. A central hole 3a having a cylindrical form has been formed by grinding on the shaft portion 3c, while the inner race element 17, after press-fitted on the shaft portion 3c, has been fixed by plastically deforming a portion 3d by caulking (or clinching) to keep the position of the rolling bearing (Fig. 3B).

In the present specification, when the hub unit which is completed by the method of the present invention is attached to the car body, the hub unit work is disposed to be turned up if a portion corresponding to an inside of the car is positioned in an upper part and a portion corresponding to the outside of the car is in a lower part, while it is disposed to be turned down in the opposite case.

Fig. 1 is a view of a broaching work according to an embodiment of the present invention, when a work for a hub unit is turned up. Fig. 2 is a view of a broaching work according to an embodiment of the present invention, when a work for a hub unit is turned down. Fig. 3A and Fig. 3B are cross sectional views of the work for the hub unit prior to the broaching work, wherein Fig. 3A shows a shape of a hole for forming a spline before plastically deforming by caulking (or clinching), and Fig. 3B shows the shape of the hole for forming a spline after plastically deforming by caulking (or clinching). Fig. 4A and Fig. 4B are respectively a whole cross sectional view and a partially enlarged cross sectional view of a seal attached to the work for the hub unit. Fig. 5 is a lateral sectional view for showing a state in which the work for the hub unit is carried in during the broaching work. Fig. 6 is a lateral sectional view for showing a state in which a tool is inserted through the work for the hub unit in the broaching. Fig. 7 is a lateral sectional view for showing a state in which a spline processing is carried out in the broaching work. Fig. 8 is a lateral sectional view for showing a state before the hub unit is carried out in the broaching work. Fig. 9A and Fig. 9B are cross sectional views for showing a rough processing for forming the spline of the hub

work for hub unit formation, wherein Fig. 9A shows a state before the broaching work, and Fig. 9B shows a state after the broaching work. Figs. 10A to 10E are characteristic diagrams for showing deformation data of a spline hole of the hub work for the hub unit.

First, a member structure for conducting a broaching work will be described with reference to Fig. 1. The hub unit work 103 which serves as a work before formation and processing of a female spline is disposed to turned up on a work stand 1, and a straight guide portion 2b of a tool 2 is inserted through a hole 3a of the work 103. The work 103 is fixed to the work stand 1 on a lower surface of the flange 3b which is a part separated from the portion 3d plastically deformed by caulking (or clinching). The tool 2 consists of a part having a cutting edge 2a and the straight guide portion 2b having no cutting edge 2a, and is moved in a direction indicated by an arrow.

Since the degree of perpendicularity of the tool 2 with respect to the upper surface (a surface in contact with the lower surface of the flange 3b) of the work stand 1 in the axial direction is set with high precision, a female spline having an excellent degree of perpendicularly on the basis of the lower surface of the flange 3b can be processed. This arrangement is effective for a hub unit for which

high precision in vibration of a brake is required.

A structure in which the hub unit work 103 (or the work 103) is disposed upside down is shown in Fig. 2. Description of the respective components in Fig. 2 is the same as that in Fig. 1 and will be omitted. The work 103 is, when the female spline is formed and processed, received by a flat surface portion 1a for plastically deforming by caulking (or clinching) of the work stand 1. This flat surface portion 1a has been processed in advance by cutting or coining. Since the degree of perpendicularity in the axial direction of the tool 2 with respect to an upper surface (a surface in contact with the lower surface of the flange 3b) of the work stand 1 is set with high precision, the female spline with high degree of perpendicularity based on the flat surface portion 1a for plastically deforming by caulking (or clinching) can be processed. Since the abutment between a flat surface portion of a constant velocity joint to be connected to this hub unit 3 by bringing a female spline shaft for constituting an output shaft into engagement with the female spline of the shaft 3c and the flat surface portion 1a can be set in an excellent state, this processing method is effective for a work which is strict with abnormal sound from such an abutment surface.

Next, description will be made on a method

according to a first embodiment of the present invention, in which, before plastically deforming by caulking (or clinching), a hole is formed by cutting on the shaft portion 3c of the hub 3 in the axial direction and then a bearing constituted by an outer race 16, rolling members 18 and the inner race element 17 are fitted and attached on the shaft portion 3c, thereafter an inner race element 17 being fixed by plastically deforming by caulking (or clinching) from the outer end side of the shaft portion 3c, and then a semi-dry or dry broaching being conducted.

As shown in Fig. 3A, the hub shaft portion 3c of the work 103 has been formed by lathing in advance with the cylindrical hole 3a through which the tool 2 is inserted. This hole 3a has such a form that the diameter thereof becomes larger at a portion nearer a portion 3d to be plastically deformed by caulking (or clinching) (upward in the drawing), that is, the diameter becomes larger for an estimated amount of deformation thereof by plastically deforming by caulking (or clinching) or an estimated amount of contraction caused by deformation by plastically deforming by caulking (or clinching) or by insertion of the inner race element 17 at a portion closer to the portion 3d to be plastically deformed by caulking (or clinching).

This is because the inner diameter of the hole 3a is contracted by plastically deforming by caulking (or clinching), as shown in Fig. 3B. If the inner diameter of the hole 3a of the hub shaft portion 3c is smaller than the outer diameter (the outer diameter of the straight guide portion 2b) of the tool 2, the tip end of the tool 2 can not be inserted in the hole 3a. To the contrary, when the inner diameter of the hole 3a is excessively larger than the outer diameter of the tool 2, the degree of concentricity of the tool 2 with respect to the hole 3a becomes low. Then, of the hole 3a of the hub shaft portion 3c, a part which is not influenced by plastically deforming by caulking (or clinching) or by insertion of the inner race element 17 is processed by cutting to have a high degree of concentricity, while a part which is greatly influenced is processed to have a form that the inner diameter after plastically deforming by caulking (or clinching) is not smaller than the outer diameter of the tool 2.

A seal 11 is attached to the outer race 16 of the work 103, as shown in Figs. 4A and 4B, in order to prevent chips from entering the bearing portion. A lip 11a of the seal 11 can be formed to be twofold by utilizing a step portion of the inner race element 17. In this structure, chips are difficult to enter.

The structure for preventing chips is not limited to that described above. A detachable cap (not shown) may be provided. The cap is attached to the work 103 before broaching and is removed after broaching. This cap is used repeatedly after the chips are taken off. The cap is particularly effective for a work with an encoder formed of multipolar magnet or a work to which a seal can not be attached. Even for a work with a seal, the cap is used sometimes in order to prevent chips from being attached to the work itself.

Description will be made now on a process for forming the female spline on the hub shaft portion 3c of the work 103 having the above configuration by broaching. As shown in Fig. 3B, the hole 3a is provided on the shaft portion 3c of the hub 3, and, as shown in Fig. 5, the work 103 plastically deformed by caulking (or clinching) is conveyed, as indicated by an arrow, to be placed on the work stand 1. In this case, the tool 2 is retained by an upper chuck 4, and an upper lid 5 serving as covering means is closed. In case of a work 103 for which chips are produced in a large amount, for safety's sake, the cutting edge 2a of the tool 2 is given a brush 6 (cleaning means) so that the chips are absorbed by a vacuum tube 7. That is, a processing called a cleaning is performed. This cleaning is required to

be finished before the work 103 is placed on the work stand 1. It is possible to employ a method that chips are to be detected by a sensor (not shown) and, when the sensor does not detect chips, cleaning is not carried out.

As shown in Fig. 6, when the work 103 is placed on the work stand 1, the upper chuck 4 which supports the tool 2 slowly descends. When the tool 2 descends up to a position near the upper lid 5, the upper lid 5 is opened (unfolded) in a lateral direction (indicated by the arrow), and the upper chuck 4 further descends so that the straight guide portion 2b of the tool 2 enters the hole 3a of the hub shaft portion 3c of the work 103, as described above. When the lower chuck 8 thereupon ascends to come near a lower lid 9 which serves as the covering means, the lower lid 9 is opened in the lateral directions (indicated by the arrows). When the upper chuck 4 slowly descends and the lower end portion of the tool 2 goes through the work 103 to reach the lower chuck 8, the lower chuck 8 catches the lower end portion of the tool 2. The upper chuck 4, after confirming that the tool 2 is caught by the lower chuck 8, releases the tool 2.

In this case, in order to prolong the life of the tool 2, oil 20 is sprayed on the tool 2 in the form of mist while the tool 2 slowly descends. As

shown in the same drawing, a nozzle 10 for spraying the mist onto the tool 2 is provided above the work 103. When the tool 2 passes by the nozzle 10, a groove of the cutting edge 2a of the tool 2 is sprayed with the mist of oil 20. An amount of the oil in this case is 5 cc/h or less, in a state of semi-dry processed.

In case of a processing employing a tool having a sufficiently long life, since the surface of the tool 2 is sufficiently smooth, the broaching work is performed in a dry condition without no sprayed oil 20. In this case, since no oil is used, oil does not permeate the work 103 so that the processing environment is not stained with oil.

If the broaching work is conducted in a semi-dry or dry condition, there is little need of performing a washing step using a spraying of, for example, an air because of the oil used in the processing, unlike in a processing under a wet condition. Further, removal of chips is easier than that in the wet processing.

The subsequent operations are as follows. First, as shown in Fig. 7, when the lower chuck 8 catches the lower end portion of the tool 2 and the upper chuck 4 releases the tool 2, the lower chuck 8 descends at a predetermined speed. After releasing the tool 2, the upper chuck 4 ascends, and the both

ends of the upper lid 5 approach to each other in directions indicated by the arrows to close the upper lid 5. when the lower chuck 8 brings the tool 2 down below the work 103 as indicated by the arrow, the lower lid 9 is closed.

A descending speed of the lower chuck 8 in this case, that is, a cutting speed in the broaching work is normally 3 m/min to 80 m/min. In the present embodiment, a comparatively high speed of 40 m/min to 80 m/min is employed. The reason for this is related to that the chips absorb the heat so that the tool 2 is hardly damaged.

Next, as shown in Fig. 8, when the tool 2 descends to pass by the work 103 and a female spline 3e is formed on the shaft portion 3c, the lower lid 9 is closed in the directions indicated by the arrows, and at the same time, the work 103 is carried out as indicated by the arrow. On the tool 2 which has descended, a cleaning operation is conducted for scraping off the chips attached onto the cutting edge 2a of the tool 2 by vibrating the brush 6, in the same manner as described above. The scraped chips are absorbed by a vacuum tube 7. Upon completion of the cleaning operation, the lower chuck 8 pushed the tool 2 upward. When the tool 2 approaches the lower lid 9, the lower lid 9 is opened in a direction opposite to that indicated by the arrows. At the

same time, the upper chuck 4 also descends and the upper lid 5 is opened. The tool 2 is pushed upward at a low to medium speed, so that the tool 2 is caused to ascend to reach the upper chuck 4. After it is confirmed that the tool 2 reaches the upper chuck 4 and the upper chuck catches the tool 2, the lower chuck 8 releases the tool 2. The lower chuck 8 descends and the lower lid 9 is closed in directions indicated by the arrows. The chuck 4 which catches the tool 2 ascends at a high speed, and the upper lid 4 is closed. Then, the cleaning of the tool 2 is started, meanwhile another work is conveyed in. After that, the operations shown in Figs. 5 to 8 are repeated.

When the hub unit is divided into three areas depending on the position of the lid, including an area higher than the upper lid 4, an area lower than the lower lid 9, and an area between the upper lid 4 and the lower lid 9, the cleaning of the tool 2 can be carried out when there is no work 103 and the broaching work after plastically deforming by caulking (or clinching) can be conducted without attaching chips onto the work 103. In case of a spline processing which leaves very little chips, the broaching work may be conducted in a structure having an upper lid only and no lower lid, or in a structure having a lower lid only and no upper lid. In case of

the spline formation and processing producing no chip, the broaching work is be in some cases conducted in a structure with no lid.

As for a method of driving the chucks 4 and 9, the upper chuck 4 is driven by an air cylinder and the lower chuck 9 by a mechanism having a servo motor and a ball screw combined with each other, respectively. The driving method is not limited to this. The upper chuck 4 or the lower chuck 9 may be driven by oil pressure.

In the present embodiment, the female spline is processed by pulling the tool 2. However, the female spline may be formed and processed by pushing the tool 2. In addition, the present embodiment employs the scheme that the tool 2 is moved downward. However, a scheme that the tool 2 is moved upward may be employed.

The tool 2 for the broaching work shown in Figs. 5 to 8 has the cutting edge 2 with a helical groove. However, it is possible to use a tool having parallel grooves. However, as a groove of the tool 2, a helical groove can be processed continuously so that the female spline can be formed with precision with a helical groove. A cut amount is 5μm to 50μm for one pitch from one cutting edge to another. In the present embodiment, a cutting amount for one pitch is set as 10μm to 30μm. A material of the tool 2 is

high-speed steel or ultra-hard metal. Such material may be coated in some cases.

Further, in the present embodiment, the brush 6 is employed as the cleaning means for the tool 2. However, the cleaning means is not limited to this. The cleaning may be conducted by spraying an air, using a washing liquid, or another means.

Next, description will be made on a method according to a second embodiment in which a rolling bearing comprising an outer race, rolling members and an inner race element is fitted and attached on a shaft portion 3c' of a hub 3', and before the inner race element is fixed by plastically deforming by caulking (or clinching), that is, before a work for a hub unit is assembled, a rough processing by broaching is conducted on the shaft portion 3c' of the hub 3', and then a finishing processing is conducted by broaching after the inner race element is fixed by plastically deforming by caulking (or clinching). The finishing processing by broaching which is conducted after the inner race element is fixed by plastically deforming by caulking (or clinching) is carried out in the same manner as described above. In the following, description will be made on a case in which the rough processing is performed by broaching prior to the plastically deforming by caulking (or clinching).

As shown in Fig. 9A, before the broaching work is conducted, a hole 3f' is formed by cutting on the shaft portion 3c' of the hub work 3' which serves as a work for hub formation. This hole 3f' is not identical to the hole 3a which is shown in Fig. 3, but has a cylindrical form with a uniform inner diameter. When a ring 12 is press-fitted onto the outer peripheral side of the shaft portion 3c' of this hub work 3', the hole 3f' is contracted toward the inner diameter side. An amount of contraction in this case is set as an amount which is obtained by adding an amount of deformation of the inner race element 17 (Fig. 3) when it is press-fitted to an amount of deformation by plastically deforming by caulking (or clinching). An amount of contraction produced by the press-fitting of the ring 12 is removed by broaching. When the ring 12 is removed from the shaft portion 3c' of the hub work 3' after the rough processing by broaching, a hole 3g' for spline formation is obtained, as shown in Fig. 9B. This spline formation hole 3g' has a form in which the inner diameter thereof is larger at a part nearer a portion 3d' to be plastically deformed by caulking (or clinching) (that is, gradually larger from lower to upper in the drawing). That is, the hole 3g' has a form which becomes larger at its part nearer the portion 3d' to be plastically deformed by caulking

(or clinching) for an estimated amount of contraction which may be caused by deformation by plastically deforming by caulking (or clinching) or press-fitting of the inner race element 17.

If the spline formation hole 3g' is shaped to have such a form by rough processing, it is possible to reduce an interference for the finishing work by broaching after having effected plastically deforming by caulking (or clinching), and to prolong the life of the tool. Or, it is possible to omit the finishing work by broaching itself. In this case, the form of the hole 3f' is contracted by press-fitting of the ring 12. However, the form of the hole 3f' may be contracted by partially chucking the outer diameter of the shaft portion 3c'. In order to smoothen the rough surface of the spline of the hub unit thus completed, a direction of moving the tool 2 in the rough processing is in some cases reversed to a direction of moving the tool 2 in the finishing work. In addition, since a washing step is required in the rough processing prior to the assembling of the bearing, the rough processing is carried out in a wet condition, and the washing step is performed after the processing.

Figs. 10A through 10E show results of measurement which is performed plural times on the form of the female spline of the shaft portion 3c of

the hub 3 by means of a cylinder gauge at four points a, b, c and d of the spline formation hole 3g in the axial direction, wherein Fig. 10B shows a result of measurement performed after the rough processing by broaching (prior to the press-fitting of the inner race element); Fig. 10C shows a result of measurement after the press-fitting of the inner race element; and Fig. 10E shows a result of measurement after the finishing work by broaching, respectively. In Figs. 10A through 10E, the ordinate represents the axial direction of the shaft portion 3c and the abscissa represents an amount of deformation. From Figs. 10B through 10E, it is seen that, since a lower part of the spline formation hole 3g is swollen and extruded by the press-fitting of the inner race element or by plastically deforming by caulking (or clinching) (particularly, by plastically deforming by caulking (or clinching)), an amount of deformation becomes greater at a lower part of the hub work 103 in the axial direction.

Accordingly, it is effective if the data on the form of the female spline shown in Figs. 10A to 10E is obtained prior to the steps shown in Figs. 3A, 3B and Figs. 9A and 9B, and thereafter the forms for the steps in Figs. 3A, 3B and Figs. 9A and 9B are determined. In both the first and second embodiments, the axial force (the force for contracting the inner

race element in the axial direction) of the hub unit hardly changes before and after the broaching work. The axial force is reduced by several hundred kgf or around for the axial force of 5 to 10 tonf. Even under the worst of the circumstances estimated, it is calculated that the axial force is reduced by 5% at the maximum.

Note that, in case of the work 103 with an encoder, in order to prevent chips from adhering, the encoder may be magnetized after a broaching work. As for the processing method, Japanese Patent Application Laid-Open Nos. 2001-287116 and 2001-269813 filed by a manufacturer of a broaching tool which is used in the experiments are referred.

As described above, according to a method of the present invention, a hole in a cylindrical form is provided on the shaft portion of a work for a hub unit by cutting, a rolling bearing is fitted and attached on the shaft portion, and, after an inner race thereof is fixed by plastically deforming by caulking (or clinching). In this case, a female spline is formed on the hole by broaching, the female spline can be formed with precision without increasing the number of the processing steps or the manufacturing cost.

Also according to another method of the present invention, the female spline is roughly processed by

broaching before the work for the hub unit is assembled, that is, before the rolling bearing is fitted and attached on the hub work and, after the rolling bearing is fitted and attached on the hub work and the inner race is fixed by plastically deforming by caulking (or clinching). In this case, the female spline is finished by broaching, it is possible to reduce the processing cost for the finishing work and to prolong the life of the tool, in addition to form the female spline with precision.

Further, according to a preferred embodiment of the present invention, it is possible to perform cleaning of the tool or, to prevent chips from entering the bearing by attaching a seal to the work for the hub unit or providing cleaning means or openable/closable covering means in the broaching work.